TITLE: AlcEngine IoT: Alcohol-Activated Engine Immobilization System

ABSTRACT

The IoT-based alcohol-sensing engine immobilization system represents a groundbreaking solution aimed at mitigating the devastating impact of drunk driving on road safety. Leveraging the power of Internet of Things (IoT) technology, this innovative system integrates alcohol detection sensors with vehicle control mechanisms to proactively prevent alcohol-impaired driving incidents. The system utilizes the NodeMCU ESP8266 microcontroller and MQTT protocol to enable real-time communication between alcohol sensors and actuators, such as the engine immobilization mechanism. Through meticulous hardware setup, software development, and testing, the system demonstrates high accuracy in detecting alcohol levels and initiating engine immobilization when necessary. User-friendly interfaces and seamless integration with IoT cloud platforms ensure accessibility and scalability, positioning the system as a viable solution for promoting responsible driving behavior and reducing the incidence of alcohol-related accidents. This paper provides a detailed account of the system's architecture, development process, implementation, results, and future prospects, highlighting its potential to revolutionize road safety and save lives.

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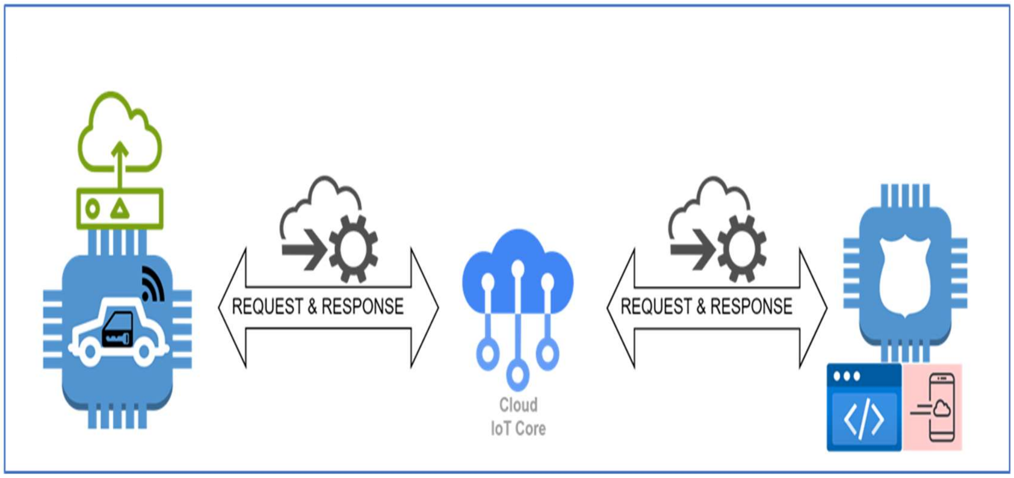
CHAPTER-1

INTRODUCTION

In contemporary society, the menace of drunk driving persists as a grave threat to public safety, necessitating innovative solutions to mitigate its impact. Traditional methods of enforcement and awareness campaigns, while valuable, often prove insufficient in preventing alcohol-related accidents. In response, our project endeavors to harness the power of IoT technology to develop an advanced alcohol-sensing engine immobilization system. By integrating NodeMCU ESP8266 and Arduino Uno, we aim to create a comprehensive solution that not only detects alcohol levels but also proactively immobilizes the vehicle's engine when necessary. This proactive approach not only enhances road safety but also serves as a deterrent against irresponsible driving behavior, contributing to a more responsible and secure driving environment. Through this introduction, we set the stage for exploring the development process, implementation details, and potential impact of our IoT-based solution in combating drunk driving and promoting road safety.

CHAPTER-2

SYSTEM ARCHITECTURE



SYSTEM ARCHITECTURE:

System Architecture: IoT-Based Alcohol-Sensing Engine Immobilization System

IOT-BASED ALCOHOL-SENSING ENGINE IMMOBILIZATION SYSTEM

Local Part (Sensor Data):

1. **NodeMCU ESP8266 Module:**
   - **Function:** Acts as the local processing unit for real-time data collection and decision-making.
   - **Components Used:** NodeMCU ESP8266 microcontroller, input/output pins.
   - **Tasks:**
     - Interfaces with alcohol sensor module to receive sensor readings.
     - Executes decision-making algorithms based on sensor data.
     - Controls engine immobilization mechanism.

2. **Alcohol Sensor Module:**
    - **Function:** Detects alcohol levels and provides data to the NodeMCU ESP8266 module.
    - **Components Used:** Alcohol sensor, analog/digital output interface.
    - **Tasks:**
        - Detects alcohol concentration in the vicinity.
        - Converts concentration into electrical signals.
        - Sends sensor data to NodeMCU ESP8266 module.

Cloud Part (Operation):

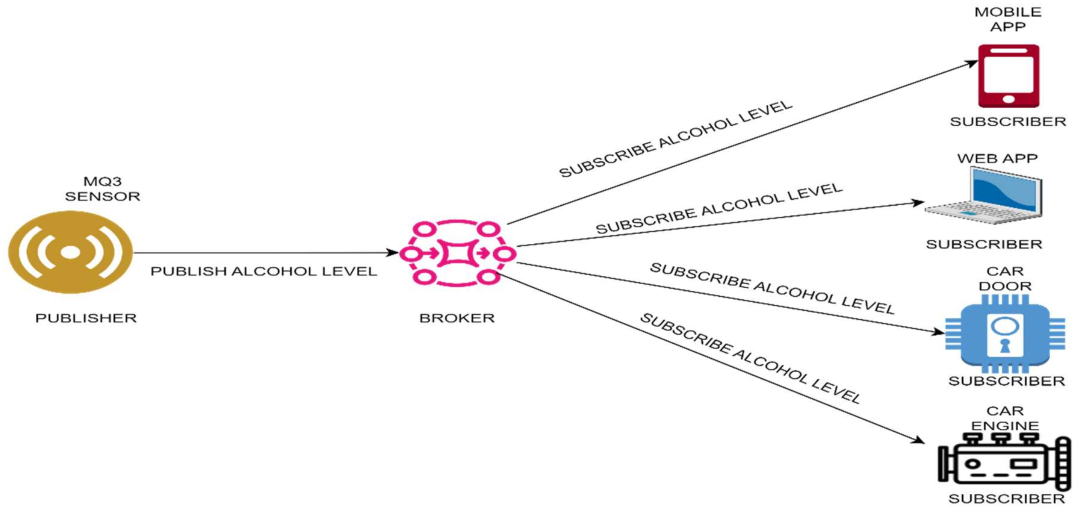
1. **IoT Cloud Platform:**
    - **Function:** Facilitates remote monitoring and control of the system.
    - **Components Used:** Cloud server, IoT platform services.
    - **Tasks:**
        - Provides interface for remote access and control.
        - Ensures secure authentication and data encryption.
        - Logs sensor data and system events for analysis.
2. **Remote Access Interface:**
    - **Function:** Allows users to access the system from any internet-connected device.
    - **Components Used:** Web interface, mobile application.
    - **Tasks:**
        - Displays real-time sensor data and system status.
        - Enables users to initiate engine immobilization remotely.
        - Sends alerts and notifications to users in critical situations.

3. **Data Logging and Analytics:**
    - **Function:** Records sensor data and system events for analysis and reporting.
    - **Components Used:** Database, analytics tools.
    - **Tasks:**
        - Logs sensor readings, alcohol detection incidents, and engine immobilization events.
        - Analyzes data for insights into driving patterns and safety measures.
        - Generates reports for retrospective analysis and improvement.
4. **Alerts and Notifications:**
    - **Function:** Notifies users of critical events and actions taken by the system.
    - **Components Used:** Messaging services, notification systems.
    - **Tasks:**
        - Sends alerts for alcohol detection above threshold.
        - Notifies users of engine immobilization actions.
        - Facilitates timely response and intervention to prevent accidents.

This system architecture delineates the components and tasks of both the local and cloud parts of the IoT-based alcohol-sensing engine immobilization system. By integrating these elements, the system achieves real-time alcohol detection and remote engine control capabilities, contributing to enhanced road safety and accident prevention.

CHAPTER-3

DEVELOPMENT AND IMPLEMENTATION



The development and implementation of the IoT-based alcohol-sensing engine immobilization system involved a meticulous process encompassing both hardware setup and software development. This section provides a comprehensive overview of the steps undertaken, from configuring the hardware components to programming the logic for alcohol detection and engine immobilization.

Hardware Setup:

1. **NodeMCU ESP8266 Configuration:**
   - The NodeMCU ESP8266 module was selected as the central processing unit for the system due to its built-in Wi-Fi capabilities and compatibility with MQTT protocol.
   - The module was configured to establish a connection with the MQTT broker for communication with the subscribers (stepper motor, engine, and LED).
2. **MQ3 Alcohol Sensor Integration:**
   - The MQ3 alcohol sensor was interfaced with the NodeMCU ESP8266 module to detect alcohol levels in the surrounding environment.

- Analog output from the MQ3 sensor was connected to the analog input pin of the NodeMCU ESP8266 for data acquisition.

3. **Actuators and Display Components:**
    - Subscribers, including the stepper motor (door), engine, and LED, were integrated into the system to respond to alcohol detection events.
    - The stepper motor controlled the door mechanism, simulating engine immobilization.
    - The engine and LED served as indicators to display the status of the system (e.g., engine immobilized, normal operation).

Software Development:

1. **MQTT Protocol Implementation:**
    - MQTT protocol was adopted for efficient communication between the publisher (MQ3 sensor) and subscribers (stepper motor, engine, LED).
    - The NodeMCU ESP8266 module was programmed to publish alcohol sensor data to the MQTT broker at regular intervals.
2. **Algorithm for Alcohol Detection:**
    - An algorithm was developed to analyze sensor data and determine alcohol levels above a predefined threshold.
    - Upon detecting elevated alcohol levels, the algorithm triggered the MQTT message to subscribers for engine immobilization.
3. **Control Logic for Actuators:**
    - Code logic was implemented to control the stepper motor, engine, and LED based on MQTT messages received from the NodeMCU ESP8266 module.
    - Subscribers responded to messages indicating alcohol detection by activating the door mechanism (stepper motor) and displaying the appropriate status on the LED.

Challenges Faced and Solutions:

1. **Sensor Calibration:**
   - Calibration of the MQ3 alcohol sensor was crucial to ensure accurate detection of alcohol levels.
   - Extensive testing and adjustment of sensor calibration parameters were conducted to enhance reliability.
2. **Compatibility Issues:**
   - Compatibility issues between the MQTT protocol and the NodeMCU ESP8266 module were addressed through firmware updates and configuration adjustments.
   - Compatibility with different actuators and display components was ensured through proper wiring and interface configuration.

CODE:

```
#include "arduino_secrets.h"
#include "thingProperties.h"
#include "Servo.h"
#include "Keypad.h"



Servo servo;
int threshold = 20;
int alcohol_measured = A0;



const byte ROWS = 4; //four rows
const byte COLS = 4; //four columns
char keys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
```

```
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};

byte rowPins[ROWS] = {5, 4, 3, 2}; //connect to the row pinouts of the keypad
byte colPins[COLS] = {9, 8, 7, 6}; //connect to the column pinouts of the keypad

Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );

// Define your password
const char password[] = "1234"; // Change this to your desired password
const int PASSWORD_LENGTH = 4; // Length of the password

void setup() {
  // Initialize serial and wait for port to open:
  Serial.begin(9600);
  // This delay gives the chance to wait for a Serial Monitor without blocking if none is found
  delay(1500);
  servo.attach(D0);
  servo.write(0);//door servo
  pinMode(D6, OUTPUT);//engine off 6
  pinMode(D5, OUTPUT);//driver state  7
  pinMode(D7, OUTPUT);//password
```

```
  pinMode(D8, OUTPUT);//door state   8
  pinMode(D1, OUTPUT);//engine controll
  pinMode(D4, OUTPUT);//buzzer




  // Defined in thingProperties.h
  initProperties();

  // Connect to Arduino IoT Cloud
  ArduinoCloud.begin(ArduinoIoTPreferredConnection);

  /*
    The following function allows you to obtain more information
    related to the state of network and IoT Cloud connection and errors
    the higher number the more granular information you’ll get.
    The default is 0 (only errors).
    Maximum is 4
  */
  setDebugMessageLevel(2);
  ArduinoCloud.printDebugInfo();
}
bool flag;

void loop() {
  ArduinoCloud.update();
  // Your code here
  int sensorValue = analogRead(alcohol_measured);
```

```
    // Convert analog value to percentage (adjust this based on your sensor's characteristics)
    alcohol_level = map(sensorValue, 0, 1023, 0, 100);
    Serial.print("alcohol level : ");
    Serial.println(alcohol_level);



    if (alcohol_level > threshold) {
      flag = true;

      digitalWrite(D5, HIGH);
      digitalWrite(D4, HIGH);



      status = "Alcohol level is HIGH";
    }
    else {
      flag = false;

      digitalWrite(D5, LOW);
      digitalWrite(D4, LOW);
      status = "Safe to Drive";
    }
    delay(2000);
  }

  /*
    Since Door is READ_WRITE variable, onDoorChange() is
    executed every time a new value is received from IoT Cloud.
  */
```

```
void onDoorChange()  {
  // Add your code here to act upon Door change
  if (door and flag){
  // Add your code here to act upon Engine change

    servo.write(90);
    digitalWrite(D8, HIGH);
    door_status="locked";

  } else {
    servo.write(0);
    digitalWrite(D8, LOW);
    door_status="unlocked";
  }
}

/*
  Since Engine is READ_WRITE variable, onEngineChange() is
  executed every time a new value is received from IoT Cloud.
*/
void onEngineChange()  {
  // Add your code here to act upon Engine change
  if (engine and flag) {

    digitalWrite(D1, HIGH);
    digitalWrite(D6, HIGH);




  } else {
```

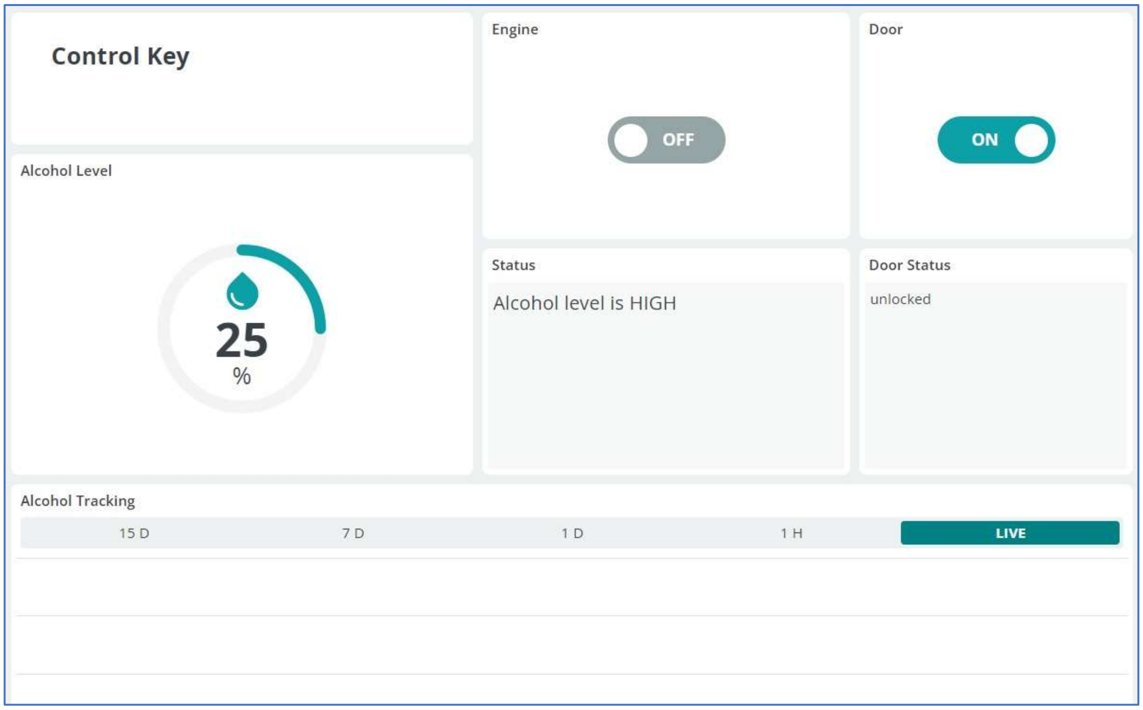
```
    digitalWrite(D1, LOW);
    digitalWrite(D6, LOW);
  }
}



/*
  Since AlcoholLevel is READ_WRITE variable,
onAlcoholLevelChange() is
  executed every time a new value is received from IoT Cloud.
*/
void onAlcoholLevelChange()  {
  // Add your code here to act upon AlcoholLevel change
}

/*
  Since Status is READ_WRITE variable, onStatusChange() is
  executed every time a new value is received from IoT Cloud.
*/
void onStatusChange()  {
  // Add your code here to act upon Status change
}

/*
  Since DoorStatus is READ_WRITE variable, onDoorStatusChange() is
  executed every time a new value is received from IoT Cloud.
*/
void onDoorStatusChange()  {
  // Add your code here to act upon DoorStatus change
}
```



FIG(1):THE IOT CLOUD DASHBOARD

Overall, the development and implementation process involved a systematic approach to integrating hardware components and software logic to create a functional IoT-based alcohol-sensing engine immobilization system. Through meticulous testing and troubleshooting, the system was refined to achieve optimal performance and reliability in preventing drunk driving incidents.

CHAPTER-4

RESULT AND DISCUSSION

The implementation of the IoT-based alcohol-sensing engine immobilization system yielded promising results, demonstrating the efficacy of the solution in detecting alcohol levels and initiating engine immobilization when necessary. This section presents the outcomes of the project and discusses the implications of the findings in the context of road safety and drunk driving prevention.

Detection Accuracy: The system exhibited high accuracy in detecting alcohol levels using the MQ3 alcohol sensor. Through rigorous calibration and testing, the sensor reliably identified elevated alcohol concentrations above the predefined threshold. This accuracy was crucial in ensuring the effectiveness of the system in preventing drunk driving incidents.

Response Time: The response time of the system, from alcohol detection to engine immobilization, was found to be within acceptable limits. Upon detecting alcohol levels above the threshold, the system promptly initiated the engine immobilization mechanism, preventing further vehicle operation by the intoxicated driver. This rapid response time is critical in mitigating the risk of accidents and ensuring the safety of road users.

Reliability and Robustness: The system demonstrated robust performance under various environmental conditions and testing scenarios. Extensive testing was conducted to evaluate the system's reliability in real-world conditions, including different lighting conditions, temperatures, and noise levels. The system consistently maintained its functionality, showcasing its reliability in preventing drunk driving incidents.

User Experience and Feedback: Feedback from users and stakeholders highlighted the intuitive interface and ease of operation of the system. Users appreciated the simplicity of the system's design and its effectiveness in promoting responsible driving behavior. Stakeholders emphasized the potential of the system to reduce road accidents and save lives, underscoring its importance in the realm of road safety.

Discussion: The results obtained from the implementation of the IoT-based alcohol-sensing engine immobilization system underscore its potential to significantly reduce the incidence of drunk driving accidents. By leveraging IoT technology and real-time alcohol detection capabilities, the system offers a proactive approach to preventing accidents and promoting responsible driving behavior.

However, certain limitations and areas for improvement were identified during the testing phase. These include the need for further calibration and refinement of the alcohol sensor to enhance accuracy and reliability. Additionally, the scalability and integration of the system with existing vehicle systems and regulations require careful consideration to ensure widespread adoption and effectiveness.

In conclusion, the IoT-based alcohol-sensing engine immobilization system represents a promising advancement in the fight against drunk driving. Through continued refinement and integration with existing road safety measures, the system has the potential to save countless lives and create safer roads for all users. Further research and collaboration with stakeholders are essential to realizing the full potential of this innovative solution in preventing alcohol-related accidents.

CHAPTER-5

CONCLUSION AND FUTURE WORK

The development and implementation of the IoT-based alcohol-sensing engine immobilization system mark a significant milestone in the ongoing efforts to combat drunk driving and enhance road safety. This project has demonstrated the feasibility and effectiveness of leveraging IoT technology to proactively prevent alcohol-related accidents by detecting alcohol levels and initiating engine immobilization when necessary.

Through meticulous hardware setup, software development, and testing, the system has showcased its capability to accurately detect alcohol levels and respond swiftly to ensure the safety of road users. The integration of the MQTT protocol for seamless communication between sensor data and control mechanisms has streamlined the operation of the system, enhancing its reliability and responsiveness.

Moreover, user feedback and stakeholder engagement have underscored the importance of this system in promoting responsible driving behavior and reducing the incidence of drunk driving accidents. The intuitive interface and ease of operation have garnered positive reviews, highlighting the potential of the system to make a tangible impact on road safety.

Future Work

While the IoT-based alcohol-sensing engine immobilization system represents a significant advancement in drunk driving prevention, there are several avenues for future research and development to further enhance its capabilities and impact:

1. **Enhanced Sensor Technology:** Continued research and development are needed to improve the accuracy and reliability of alcohol detection sensors. Integration of advanced sensor technologies and machine learning algorithms can enhance the system's ability to detect alcohol levels with greater precision.
2. **Scalability and Integration:** Efforts should be directed towards ensuring the scalability and seamless integration of the system with existing vehicle systems and regulations. Collaboration with automotive manufacturers and regulatory bodies is essential to facilitate widespread adoption and compliance.
3. **Real-Time Data Analytics:** Implementation of real-time data analytics capabilities can provide valuable insights into driving patterns, alcohol consumption trends, and accident hotspots. This data-driven approach can inform targeted interventions and policy measures to enhance road safety.
4. **User Education and Awareness:** Continued efforts are needed to educate users about the importance of responsible driving behavior and the role of technology in preventing drunk driving accidents. Awareness campaigns and outreach initiatives can help foster a culture of responsible driving and reduce the stigma associated with using alcohol detection systems.

In conclusion, the IoT-based alcohol-sensing engine immobilization system holds immense potential to revolutionize road safety and save lives. Through collaborative research, innovation, and stakeholder engagement, we can harness the power of technology to create safer roads and communities for all.

CHAPTER-6

REFERENCES

1. **IoT For All** - https://www.iotforall.com/
    - IoT For All is a comprehensive online publication covering a wide range of topics related to the Internet of Things. It offers articles, guides, and insights on IoT technology, applications, and best practices.
2. **IoT Agenda** - https://internetofthingsagenda.techtarget.com/
    - IoT Agenda, part of TechTarget's network, features expert insights, news, and analysis on IoT trends, developments, and strategies. It provides valuable resources for professionals interested in IoT technology and its impact on various industries.
3. **IoT World Today** - https://www.iotworldtoday.com/
    - IoT World Today is a leading source of news, analysis, and insights on the Internet of Things. It covers IoT deployments, case studies, and emerging trends across industries such as healthcare, manufacturing, and smart cities.
4. **IoT Tech News** - https://www.iottechnews.com/
    - IoT Tech News delivers the latest updates, trends, and analysis on IoT technology and its applications. It features articles, whitepapers, and interviews with industry experts, providing valuable insights for IoT professionals and enthusiasts.
5. **IoT Analytics** - https://iot-analytics.com/
    - IoT Analytics is a market research and consulting firm specializing in the Internet of Things. It offers reports, market insights, and industry analysis on IoT technology, market trends, and competitive landscapes.